

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1 - 16 (Canceled)

17. (Previously Presented) A valve for controlling flow rate and/or pressure comprising:

a valve body defining an inlet, an outlet, a seat, a first port, a low pressure chamber, and a high pressure chamber;

a first valve member moveable between a first valve member closed position and a first valve member open position, wherein at least a portion of the first valve member is in contact with the seat in the first valve member closed position, and the at least a portion of the first valve member is spaced a predetermined distance from the seat when the first valve member is in the first valve member open position;

a piezoelectric portion for receiving a voltage, wherein at least a portion of the piezoelectric portion is moveable relative to the valve body, and wherein the piezoelectric portion is a ring disc, the piezoelectric portion having a plurality of holes formed therein which allow the passage of fluid through the piezoelectric portion during use of the valve when the first valve member is in the first valve member open position in order to reduce resistance of the piezoelectric portion to movement thereof, the piezoelectric portion being positioned in the low pressure chamber; and

a first needle coupled to the piezoelectric portion and being moveable between a first needle open position and a first needle closed position, wherein at least a portion of the first needle is in contact with at least a portion of the first port when the first needle is in the first needle closed position, thereby defining a first boundary between the low pressure chamber and the high pressure chamber, and wherein the first valve member, in the first valve member closed position, defines a second boundary between the low pressure chamber and the high pressure chamber.

18. (Previously Presented) The valve of claim 17, wherein at least a portion of the first valve member is moveable generally parallel to an axis of the piezoelectric portion.
19. (Canceled)
20. (Previously Presented) The valve of claim 17, wherein the first needle is coupled generally coaxially to a central portion of the piezoelectric portion.
21. (Currently Amended) The valve of claim 17[~~19~~], further comprising a restriction part interposed between the first valve member and the first needle, wherein the restriction part includes a restricted passageway, and wherein the restricted passageway provides a restricted flow area that is less than a first port flow area when the first needle is in the first needle open position.
22. (Currently Amended) The valve of claim 17[~~19~~], wherein the first needle includes a body portion and a needle portion, and the body portion is positioned within the low pressure chamber.
23. (Currently Amended) The valve of claim 17[~~19~~], further comprising a spring exerting a biasing force to bias the first needle toward the first needle closed position.
24. (Previously Presented) The valve of claim 17, wherein at least a portion of the first valve member defines a portion of the high pressure chamber.
25. (Previously Presented) The valve of claim 17, wherein the valve body further defines a first valve member abutment, and wherein at least a portion of the first valve member contacts at least a portion of the first valve member abutment when the first valve member is in the first valve member open position.

26. (Previously Presented) The valve of claim 17, wherein the first valve member is defined by an axial cavity formed therein.

27. (Previously Presented) The valve of claim 26, wherein the first valve member is further defined by a passageway connecting the cavity in fluid communication with the inlet.

28. (Previously Presented) The valve of claim 17, wherein the first valve member is coupled to the piezoelectric portion for moving the first valve member between the first valve member open position and the first valve member closed position.

29. (Canceled)

30. (Previously Presented) The valve of claim 17, wherein the first valve member is in the first valve member closed position when the voltage is about zero.

31. (Previously Presented) The valve of claim 17, wherein the piezoelectric portion is configured such that it has a concavity directed towards the first needle when the voltage is about zero.

32. (Canceled)

33. (Currently Amended) A valve comprising:

a valve body defining an inlet, an outlet, and a seat;

a first valve member moveable between a first valve member closed position and a first valve member open position, wherein at least a portion of the first valve member is in contact with the seat when the first valve member is in the first valve member closed position, and the at least a portion of the first valve member is spaced a predetermined distance from the seat when the first valve member is in the first valve member open position;

a piezoelectric portion, wherein at least a portion of the piezoelectric portion is moveable relative to the valve body,

wherein the first valve member is further defined by an axial cavity in fluid communication with the inlet, the valve body is further defined by a low pressure chamber portion and a high pressure chamber portion, the high pressure chamber being formed in part by the axial cavity, the first valve member, when in the first valve member closed position, defines a boundary between the low pressure chamber and the high pressure chamber, and wherein the low pressure chamber is in fluid communication with the high pressure chamber when the first valve member is in the first valve member open position; and

a restriction part located in the high pressure chamber and having a restriction passageway which allows the passage of fluid from one side of the restriction part to another side of the restriction part, both sides of the restriction passageway being located in the high pressure chamber, wherein the restriction part remains stationary as the first valve member moves from the first valve member closed position to the first valve member open position.

34. (Previously Presented) The valve of claim 33, wherein the piezoelectric portion is a disc having a first surface, and wherein at least a portion of the first surface is selectively deformed as the first valve member moves relative to the valve body.

35. (Previously Presented) The valve of claim 34, wherein a voltage is applied to the piezoelectric portion to deform the at least a portion of the first surface.

36. (Previously Presented) The valve of claim 33, wherein the first valve member selectively moves between the first valve member closed position and the first valve member open position as a result of deformation of the piezoelectric portion.

37. (Previously Presented) A valve comprising:

a valve body defining an inlet, an outlet, a high pressure chamber in fluid communication with the inlet, and a low pressure chamber;

a piezoelectric portion located in the low pressure chamber and moveable relative to the valve body, the piezoelectric portion comprising a ring disc;

a first needle coupled to the piezoelectric portion and moveable between a first needle open position and a first needle closed position, when the first needle is in the first needle closed position the first needle forms a first boundary between the low pressure chamber and the high pressure chamber;

a second needle separate and distinct from the first needle, and moveable between a second needle open position and a second needle closed position, when the second needle is in the second needle closed position the second needle forms a second boundary between the low pressure chamber and the high pressure chamber; and

a restriction part located in the high pressure chamber between the first needle and the second needle, the restriction part having a restriction passageway which allows the passage of fluid from one side of the restriction part to another side of the restriction part, the restriction passageway having a smaller size than a passageway formed at the first boundary;

wherein the high pressure chamber is located between the first needle and the second needle, and when a voltage is applied to the piezoelectric portion, movement of the piezoelectric portion causes the first needle to move to the first needle open position which opens the first boundary and results in a pressure drop in the high pressure chamber, the pressure drop causing the second needle to move to the second needle open position.

38. (Previously Presented) The valve of claim 17 further comprising a restriction part that is separate and distinct from the first valve member and the first needle, the restriction part being located in the high pressure chamber between the first valve member and the first needle, the restriction part having a restriction passageway which allows the passage of fluid from one side of the restriction part to another side of the restriction part.

39. (New) The valve of claim 33 wherein the restriction part is separate and distinct from the first valve member.

40. (New) The valve of claim 33 wherein the first valve member moves from the first valve member closed position to the first valve member open position without the assistance of a spring.